

LECTURE: 3

ETD 801S: Science, Technology & The Development Process

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TIME: 3:30 – 6:30 PM

VENUE: LT 11

Presentation Outline

- The Neoclassical and Evolutionary Theories of Technological Change
- The Sabato's Triangle on the Interaction between science and Technology
- The Triple Helix Model of Innovation

The Neoclassical and evolutionary theories of technological change

Neoclassical theory of industrial development or how firms develop

- The theory assumes that firms face **well-behaved production functions** where all technological options or alternatives are known perfectly, and **can be accessed at no cost**; and the choice of any particular technology is the result of optimizing behaviour of firms in the bid to allocate resources on the basis of capital/labour costs.

The Neoclassical theories of technological change cont'

- *Technical change* in this framework is a shift of the production function resulting from some unexplained exogenous innovation, or from firms optimizing R&D choices with predictable outcomes.
- Free markets optimize resources allocation and there is no need for government intervention (but provides a stable macroeconomic climate, essential 'public goods')

Dynamics of industrial development – evolutionary perspective

- A new firm starts by mastering the operational **know-how of simpler technologies (equipments)**.
- At a later stage more **complex skills need to learnt** – “adaptation (of technology) and improvement; substitution of inputs; modification of products; learning product design and the principles behind the process and equipment; new product and process development; and finally, innovation in a more basic sense”. **This is a stage of know-why. At this stage, formal R&D becomes critical as firm try to “create new products and processes.**

Dynamics of industrial development – evolutionary perspective cont'

- Each step of the learning process has **its own costs**. The movement to “more complex technologies leads to greater local value added, higher wages and a more dynamic pattern of export competitiveness”.
- Good policies for technological and industrial dev't may be regarded as the results of interplay between:
 1. Innovative opportunities
 2. The incentives to exploit those opportunities
 3. The capabilities of the agents to achieve success
 4. The organizational arrangements and mechanisms through which technological advances are search for and implemented.

Neoclassical theory of innovation

■ Key issues:

- It emphasizes the importance of demand in stimulating innovative activity and determining the timing and location of innovation.
- It also emphasize changes in relative factor prices as a spur to innovation – to economise the use of the factor which has become expensive, or indeed to reduce total cost.
- When it comes to incentives to innovate, neoclassical theory lays emphasis on how much resources are devoted to R&D.

Neoclassical theory of innovation

- The motivation and the decision to undertake R&D and the resources allocated to this activity *depend on the extent of the rent streams coming from successful innovations.*

- *The implications making R&D activities determined by market forces are that:*

- if the country or industry is not already well off in R&D activities then no resource should be devoted to R&D, because it will not be profitable to do so.

- Government promotion of R&D is likely to diminish welfare because the policy induces a waste of national resources during the period of technological catch up.

Evolutionary theory of innovation

Evolutionary theory says that: Even though innovation offers profit to the innovating individual, firm or country,

- it is also uncertain in term of the actual returns on resources invested, and its ultimate economic and social acceptability.
- it is impossible to forecast technological change.
- Technology keeps changing all the time.
- Furthermore, technological changes build on previous experience and knowledge. Hence, as knowledge grows usually through “learning by doing” and “learning by using”, unit costs of production decline.

Evolutionary theory of innovation cont'

There are reasons other than profit maximization or cost minimization which motivate firms to undertake R&D:

- to catch up with technology leaders.
- to be first to develop new products and processes
- to keep up with technical developments in order to be ready to exploit opportunities as they arise.
- to be created, promoted, and fostered support to the society.
- to gives rise to more R&D

Transfer of technology or international diffusion of technical knowledge

■ *Neoclassical perspective:* Technology is transferred in different way:

- through technical cooperation programmes,
- the purchase of foreign know-how as in the form of licenses and patents,
- foreign investment,
- the purchase of capital equipment and capital,
- published material,
- foreign training and conferences.

NB: The transfer of technology is fairly easy, smooth, and more or less costless.

Transfer of technology or international diffusion of technical knowledge

Evolutionary perspective: they are of the mind that;

- Firm that invests in technology development like to protect their results through patents and secrecy.
- Even if technology could be seen as a book of blueprints and therefore easily transferable, a certain expertise is required to interpret and apply the engineering principles to a real-life situation. *Firms or countries often lack this capacity; even when possible it requires heavy capital investment.*
- Only a portion of technological knowledge is codified in the form of basic principles; a good proportion is tacit or unwritten. Some skills take considerable time to learn. ¹²

The Sabato's Triangle (University-industry interactions)

- Jorge Sabato, suggested a strategy to use S&T to overcome Latin America's state of under development.
- Sabato's triangle was a proactive strategy aimed to both force and enable the participation of Latin America in S&T with the view of successfully achieving this objective by the year 2000.
- **The issue was how to insert S & T** into the development process and “how to innovate”.
- Innovation, as understood by Sabato, meant the **“incorporation of knowledge** – one's own or alien – directed toward generating or changing productive process”.

The Sabato's Triangle Cont'

- According to Sabato, in order for development to take place, it was necessary to construct a regions S&T infrastructure linked to the productive structure of the society.
- This process involved the multiple and coordinate actions of three vertices of society: **government (g)**; the **productive structure (e)** *[including private and government-owned companies]* and the **science-tech infrastructure (z)** *[including universities, public and private research and development centres]*.

The Sabato's Triangle Cont'

- Sabato posted a set of these types of relationship among the elements of the triangle: **intra-relations** (*within the vertices*) and **extra-relations** (*with the government directing the two other vertices*). This concept for science-based development was premised upon the **government triggering** a process of strong inter-relations among the three players.
- The **cornerstone** of the S&T revolution in the 2nd half of the 20th century was perceived by Sabato as resulting from a **purposeful process of interrelations**.

The Sabato's Triangle Cont'

- In his terms, it occurred through commands circulating down from the top vertex g, to the vertices at the base of the triangle, “e and z”; and horizontally between the last two vertices.
- Lack of capacity to internally translate from one institutional sphere to another was characteristic of organizational underdevelopment.
- According to Sabato, the US put all its scientific potential to use through the government acting upon the other two vertices, formulating policies and mobilizing resources.

[The Triple Helix Model of Innovation]

- The organizational principle of the triple helix is the expectation that the university will play a co-operates role in society, the so-called “Third Mission”.
- The Triple Helix Thesis is that the University-Industry-government interaction is the key to improving the conditions for innovation in a knowledge-based society.
- Industry is member of the triple helix as the locus of production; the government as the source of contractual relations that guarantees stable interactions and exchange.
- The university as a source of new knowledge and technology, the generative principle of knowledge-based economies.

The Triple Helix Model of Innovation

- The triple helix explains the formation and consolidation of learning societies, deeply rooted in knowledge production and dissemination and a well-articulated relationship between university industry and government.
- Nevertheless, the triple helix model can be used as a strategic tool to open up roads for a catch-up process, with *an ultimate goal of creating a learning society.*
- The triple helix model involves a **wholistic approach** to innovation based on the networking of diverse organizations and disciplines. As a networking exercise, it seeks to promote rapid learning through proximity and collaboration between the main actors.

The Triple Helix Model of Innovation

- The key features of the triple helix model derived from theories of innovation starting from Schumpeter contribution to the analysis of the role of innovation in the process of economic change.
- The triple helix model is a further development of the technology economic paradigm introduced by Freeman and Perez (1988). This paradigm is based upon the feedback deriving from the interaction between the economic, social, political and institutional spheres which influence the development and diffusion of innovation.

[The Triple Helix Model of Innovation]

- For the **triple helix model**, innovation is caused by the **interaction of key players or actors** in the model on their own, individual players are ineffective. This multi-factor approach network system to innovation indicates that, most of the major innovations take place as a result of the interaction between technology, science and the market.

Factors inhibiting implementation of the Triple Helix Model

■ Most barriers to the successful implementation of the triple helix model arise mainly from **inadequate technology and learning policies, insufficient commitment and internal awareness by the participating organization or institutions**. Some of these barriers include:

- **Prevalence of strong culture of centralizes economy and bureaucracies.**
- **Reliance is state-funding of innovative activities**
- **Absence of policies to provide for the development national and regional innovative system.**
- **Lack of a close relationship between business and universities.**
- **Short term approaches to businesses**

Factors inhibiting implementation Triple Helix Model of Innovation

- Lack of commitment to the concepts of partnership, learning and innovation
- Lack of strategic leadership
- Inappropriate organizational structure
- Lack of common purpose and transparent and mutually beneficial goals
- Resistance to the sharing of information procedures and processes.
- Inappropriate distribution of risks
- Inappropriate learning of approaches
- Inappropriate distribution and exercise of power, deriving from hierarchical organizational structure.

SYNERGY TIME

- Any problem should be brought forward for discussion.
- Suggestions are welcome
- Wise saying & inspirational words

LETS ENJOY OUR STAY